Shift your work

van de Ven, Hardy Adriaan

CHAPTER 7

Workers' attitude towards change in the implementation of new shift systems

Authors

Hardy A van de Ven (1,2), Ute Bültmann (1), Jac JL van der Klink (1,3), Wendy Koolhaas (1), Anneke Goudswaard (2,4), Sandra Brouwer (1), Michiel P de Looze (2,5)

Affiliation

1 Department of Health Sciences, Community and Occupational Medicine, University Medical Center Groningen, University of Groningen, Groningen, the Netherlands
2 TNO, Leiden, the Netherlands
3 Tranzo Scientific Center for Care and Welfare, Tilburg School of Behavioral Sciences, Tilburg University, PO Box 90153, 5000LE Tilburg, the Netherlands
4 Windesheim, University of Applied Sciences, Almere, the Netherlands
5 Department of Human Movement Sciences, VU University, Amsterdam, the Netherlands

Abstract

Shift system interventions affect worker health and wellbeing. Although it is acknowledged by shift work experts that the workers' attitude towards a shift system intervention may affect evaluation results, no studies have directly examined this assumption. The objective of this study was to examine whether the workers' attitude towards a shift system intervention is associated with a change in health, work functioning, work ability and work-family interference. This study used a pre-/post-measurement design for the evaluation of five shift schedule interventions at five companies in the Netherlands. Complete follow-up data were available from N=59 shift workers (37.1%) at baseline and 6-8 months after the interventions. Paper questionnaires were used to assess attitude towards a shift system intervention, health status, work functioning, work ability and work-family interference. Multivariate linear regression was conducted, adjusted for age, gender, baseline scores, and follow-up time. A positive attitude towards a shift system intervention was prospectively associated with better scores on mental health, work ability and work-family interference. The findings confirmed that workers' attitude towards implementing new shift systems affect health and work outcomes. Intervention studies with larger sample sizes are needed to replicate our findings and extend to other shift work-related measures, like sleep and fatigue.

Introduction

Shift work, including night work, is considered a risk factor for health and wellbeing. Biological and social circadian rhythms are disturbed, resulting in an increased risk for developing sleep problems, cardiovascular diseases, gastrointestinal diseases, metabolic syndrome and work-family interference (1-7). To reduce or prevent the negative effects of shift work, several countermeasures have been proposed (8). Countermeasures range from individual interventions, such as bright light therapy and melatonin administration, to organizational interventions, like the (re-)design of shift systems or schedules. To optimize shift systems, it has been argued that interventions should aim at minimalizing circadian disruption and accumulation of sleep loss, while maximizing time for recovery and participation in social activities (9, 10). Beneficial results have been found for minimizing the number of consecutive working days and shifts, rotating forwards (i.e. M(orning) to E(vening) to N(ight) instead of NEM), avoiding weekend work and quick returns (i.e. less than 11 hours between consecutive shifts) and starting the morning shift preferably at 7:00 o'clock or later (9-11). In addition, increasing work time control may also lead to better health, recovery and less work-family interference (12-14).

New shift systems may have a large impact on individual workers. Shift workers have to adjust physically and mentally and the social life has to be rearranged. Moreover, changes in day-to-day routine, like carpooling to work, may cause major discussions among workers when implementing new shift systems (14). Furthermore, shift system interventions are often accompanied with fear of losing financial benefits, which is a major reason for working in shifts (15). Therefore, not all shift workers will have a positive attitude towards a shift system intervention (16).

In effect evaluations of new shift systems on health and social wellbeing, it has been suggested that the attitude of shift workers towards the new shift system may affect the results. Already in 1998, Smith et al. (17) noted that among three trials from a slowly backwards rotating schedule to a fast forward rotating schedule, least improvement in health and wellbeing was found for the trial in which the lowest percentage of workers voted in favor of a new schedule. More recently, Albertsen et al. (14) found among three self-roster interventions the largest positive effect on health and wellbeing for the intervention with the lowest level of resistance to change among workers.

Large individual differences in preferences for shift systems have been described (18-21). In a study among eldercare workers, older age was associated with less dissatisfaction about the current shift schedule (Nabe-Nielsen 2010). In another study, younger police officers had a more positive attitude towards a fast forward rotating schedule compared to their older counterparts (19). Yet, in previous studies evaluating new shift systems, the workers' attitude towards the implementation of a new shift system has not directly been examined in relation to effects on health, work and social wellbeing. More insight in the effect of the attitude towards change on evaluation results might help to better explain results of future

shift system intervention studies.
Hence, the objective of the current study was to investigate whether the workers' attitude towards a shift system implementation is associated with changes in self-rated health, work functioning, work ability and work-family interference during follow-up.

Methods

Study sample and procedure

This study is part of the 'Shift Your Work' study (22, 23). A pre-/post-measurement design was used. Data were gathered in 2013-2014 before and after the implementation of new shift systems at five companies in the Netherlands comprising a total of N=159 shift workers. Paper questionnaires were sent to all shift workers before the shift system implementation and six to eight months after the shift system implementation. Follow-up time varied due to summer holidays. During these holidays, an adjusted shift schedule was applied to accommodate lower personnel capacity. The five interventions were initiated, designed and implemented by the companies, without interference of the research team. All shift workers were informed about the design and aim of the evaluation study by the research team and company representatives. Ethical approval was provided by the Medical Ethics Committee of the University Medical Center Groningen (METc 2010.332).

Shift schedule interventions

Table 7.1 presents the old and new shift schedules for the five companies. Although reasons for intervening differed between the five companies, all new shift systems were designed to improve the working times by adhering to ergonomic shift scheduling recommendations (9, 10)
Intervention 1 took place at a full-continuous production facility of a multinational in the process industry. The intervention comprised a reorganization in which the teams of two different plants were merged into one team responsible for both plants. All shift workers were cross-trained to obtain the necessary skills for operating both plants. Both teams had different shift schedules and changed towards the same fast forward rotating shift schedule. For one team, the intervention comprised a change to a totally different schedule (Intervention 1A, N=23). The old shift schedule was a self-developed customized shift schedule to maximize weekends off (Saturdays and Sundays). For the other team the change was rather small, i.e., only the number of consecutive working days changed (Intervention 1B, N=41).
Intervention 2 was performed at another full-continuous production facility of the same multinational as intervention 1. The intervention was initiated by the shift workers (N=15) and approved by the management. Based on positive experiences of shift workers from a nearby company, the shift schedule was changed from a slowly backward rotating shift schedule to a fast forward rotating shift schedule.
Intervention 3 was conducted at a production department of a large pharmaceutical company. The company forecasted an increase in production volumes transcending their current

production capacity. The shift workers (N=46) could choose between several options and opted for a change from a regular semi-continuous shift schedule with weekends off to an irregular semi-continuous shift schedule including Saturdays (and Sundays off), while the original three teams were split into seven teams.

Intervention 4 was conducted at a chemical production facility of a multinational due to declining production volumes. The workers (N=27) had to choose between downsizing personnel capacity or downsizing production time, with a decrease in salary. The latter was chosen, resulting in a change from a collective full-continuous fast forward rotating shift schedule including weekends to a personalized semi-continuous fast forward rotating shift schedule with a production stop each second weekend.

Intervention 5 took place at a production department of a company producing soft drinks and was similar to intervention 3 (N=34 workers). A business case was made for an increase in production volume, favoring a new shift system. The shift schedule changed from a traditional three-team semi-continuous shift schedule with weekends off to a seven-team semi-continuous shift schedule including Saturdays and Sundays off.

Measures

Shift workers' attitude towards the shift system implementation

Attitude towards the shift system implementation was measured prior to implementation (baseline) with two self-constructed items: "I have a positive attitude towards the shift schedule intervention", and "I accept the consequences of the shift schedule intervention". Answers could be provided on a five-point Likert scale ranging from 1 "I totally agree" to 5 "I totally disagree". An inversed sum score was constructed by averaging the two items, with higher scores indicating a more positive attitude towards a shift system intervention. The Cronbach's alpha was 0.88.

Outcome measures

Self-rated health, work functioning, work ability and work-family interference were assessed at baseline before the intervention and at follow-up 6-8 months after the interven-

Table 7.1. Shift system interventions (M=Morning shift, E=Evening shift, N=Night shift, x=day off)

Intervention	Reason for change	Old schedule	New schedule
Intervention 1A	Reorganization	MMMMxEEExxxMMMxxNNN-NxxEEEExNNNxxxxx	MMEENNxxxx
Intervention 1B	Reorganization	MMMEENNxxxxxMMEEEN-NxxxxxMMEENNNxxxx	MMEENNxxxx
Intervention 2	Sustainable employment	NNNxxEEExxMMMxx	MMEENNxxxx
Intervention 3	Increase production volumes	NNNNNxxEEEEExxMMMMMxx	ENNNxxxMxEEExxNNxMMMExEENNNxxxMMMExNN-NxxMMxMMEEExx
Intervention 4	Decrease production volumes	MMEENNxxxx	Individual schedule
Intervention 5	Increase production volumes	NNNNNxxEEEEExxMMMMMxx	ENNNxxxMxEEExxNNxMMMExEENNNxxxMMMExNN-NxxMMxMMEEExx

tion. Change scores were computed as the difference between baseline and follow-up.
Self-rated health was assessed with the Short-form 12 (SF-12) (24). The SF-12 is a widely used generic health status measure and comprises a mental (MCS12) and physical (PCS12) component. Both components range from 0-100, with higher scores indicating better health, and are constructed to have a norm-based mean of 50, with a standard deviation of 10.
Work functioning was measured with the Work Role Functioning Questionnaire 2.0 (WRFQ) (25). The WRFQ consists of 27 items assessing the perceived difficulties of meeting work demands due workers' physical health or emotional problems. Answer categories range on a 5-point Likert-scale from "Perceived difficulties all the time (100%)" to "No perceived difficulties at all (0%)". Also an option "Does not apply to my job" is included. Scores are transformed into a score ranging from 0-100, with higher scores indicating better work functioning.
Work ability was assessed with a single item from the Work Ability Index (WAI) (26), asking about workers' current work ability compared to their lifetime best. Scores range from 0-10, with higher scores indicating higher work ability. The single-item work ability score (WAS) is strongly associated with the 10-item WAI (27) and shows good convergent validity (28).
Work-family interference was assessed with six items from the Copenhagen Psychosocial Questionnaire II on work to family conflict (WFC, four items) and family to work conflict (FWC, two items) (29). Both dimensions were measured on a 4-point Likert-scale, ranging from "Yes, often" to "No, never". The scale scores were calculated by averaging the answers to the individual questions and transforming into scores from 0-100 scores. Higher scores indicate higher work to family conflict or family to work conflict.

Covariates
Age, gender, and care for children were assessed at baseline (=before implementation). Age was measured by date of birth. Care for children was measured by household composition and dichotomized into living with or without children at home. Moreover, the time between the pre- and post-measurement was included as a covariate in the analyses.

Statistical analyses

All participants with complete data at baseline and follow-up were included in the analyses. To examine associations of a workers' attitude towards the new shift systems on change in self-rated health, work functioning, work ability and work-family interference, stepwise linear regression analyses were used First, all associations were tested crude. Second, the analyses were adjusted for age, gender, care for children, baseline scores of self-rated health, work functioning, work ability and work-family interference and time between baseline and follow-up. The crude analyses were repeated for the individual interventions. All analyses were performed with IBM statistics 23.

Results

Study sample characteristics

The final study sample with complete data at baseline and follow-up comprised N=59 shift workers (37.1%). The percentage of shift workers with complete data differed between the interventions, ranging from 66.7% (Intervention 1A and Intervention 2) to 5.9% (Intervention 5). In Table 7.2, the mean scores and standard deviations are presented for the total study sample and for workers of the individual interventions with a study sample of at least N=10.

Attitude towards the shift system implementation and (changes in) the outcome measures

A more positive attitude towards a shift system intervention at baseline was significantly associated with better mental health (β 3.14, 95% CI 1.32-4.97), better work functioning (β 3.95, 95% CI 1.17-6.73), better work ability scores (β 0.52, 95% CI 0.22-0.81) and less work-family conflict (β -5.62, 95% CI -9.92 - -1.32). No crude associations were found for physical health and family-work conflict. The small sizes restricted further analyses to interventions 1 and 2. A more positive attitude towards a shift system intervention was associated with less work-family conflict in intervention 1A (β -6.46, 95% CI -12.79 - -0.14) and better mental health in intervention 1B (β 4.96, 95% CI 0.43-9.48). No associations were found for the other measures (Table 7.3).

Due to the small sample size, it was not possible to adjust the analyses for all covariates and the baseline scores of self-rated health, work functioning, work ability and work-family interference in one model. Instead, we adjusted the crude results separately for the covariates and the baseline scores. After adjustment for age, gender, care for children and time between baseline and follow-up, the associations with mental health (β 3.44, 95% CI 1.44-5.43) and work-family conflict (β -6.31, 95% CI -10.94 - -1.67) became slightly stronger, while the association with work ability (β 0.43, 95% CI 0.12-0.74) became slightly weaker. Furthermore, the association with family-work conflict became significant (β -5.19, 95% CI -9.76 - -0.62), while the association with work functioning lost statistical significance (β 2.71, 95% CI -0.26-5.67). Adjusting for baseline self-rated health, work functioning, work ability and work-family interference, the association with work functioning became stronger (β 4.04, 95% CI 1.20-6.08), while the associations with mental health (β 2.38, 95% CI 0.73-4.04), work ability (β 0.43, 95% CI 0.12-0.74) and work-family conflict (β -3.57, 95% CI -6.94 - -0.20) became weaker.

Post-hoc analyses

Post-hoc analyses revealed no differences in self-rated health, work functioning, work ability and work family interference before and after implementation. Also, no associations were found for the attitude towards the shift system intervention with baseline scores of self-rated health, work functioning, work ability and work family interference.

Table 7.2. Study sample characteristics (SD=Standard deviaton)

	Total (N=59)		Intervention 1A (N=14)*		Intervention 1B (N=18)*		Intervention 2 (N=10)*	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Age	46.95	9.28	47.14	13.39	44.94	10.57	44.80	3.16
Gender (male) (N(%))	54	91.53	14	100.00	18	100.00	10	100.00
Care for children (yes) (N(%))	35	59.32	7	50.00	11	61.11	7	70.00
Attitude towards change	3.52	1.20	2.96	1.22	4.17	0.84	4.05	0.96
Baseline								
Mental health	50.98	5.41	52.53	3.62	50.14	6.16	49.43	3.57
Physcial health	52.03	4.39	52.98	3.49	52.27	3.48	52.46	3.42
Work functioning	86.94	13.30	87.65	12.33	89.52	7.88	86.44	21.14
Work ability score	8.00	1.30	7.71	1.07	8.00	1.24	8.00	1.89
Work-family conflict	53.50	16.79	50.00	13.87	56.25	18.44	54.38	19.99
Family-work conflict	36.65	15.55	38.39	11.46	38.89	20.06	33.75	16.72
Follow-up								
Mental health	49.04	7.60	48.46	7.10	51.26	4.67	52.85	4.21
Physcial health	51.88	7.55	50.42	8.62	53.87	3.60	54.39	3.84
Work functioning	86.78	16.39	88.65	6.95	92.50	7.42	89.62	23.90
Work ability score	7.76	1.33	7.57	1.45	8.28	0.83	8.20	0.79
Work-family conflict	51.27	18.27	51.34	16.29	47.22	17.84	47.50	16.72
Family-work conflict	38.14	14.20	41.96	14.38	33.33	11.34	35.00	14.19

* Because of insufficient response, no mean scores and standard deviations are presented for Interventions 3-5.

Shift workers were invited to fill in the follow-up questionnaire, even if they had not filled in the baseline questionnaire. The vast majority of participants with incomplete data filled in only the baseline or the follow-up questionnaire. Comparisons between shift workers with and without complete data (N=59 vs. N=27-44) revealed that shift workers with incomplete data were likely to be younger (mean 43.17 vs. 46.95 years, p=0.02). The attitude towards the shift system intervention did not differ between complete and incomplete cases. At baseline, no differences were found for self-rated health, work functioning, work ability and work-family interference. At follow-up, shift workers with complete data reported better mental health (mean 49.04 vs 43.77, p<0.02), better physical health (mean 52.03 vs. 49.79, p<0.03), higher work functioning (mean 86.78 vs. 69.50, p<0.01), and less work-family conflict (mean 51.27 vs. 61.15, p<0.05).

Discussion

This study examined the effect of the attitude towards a shift system intervention before implementation on changes in self-rated health, work functioning, work ability and work-family interference after implementation. A positive attitude at baseline was associated with better self-rated mental health and work ability, and less work-family conflict at follow-up.

No associations were found with changes in physical health.

Our results are in line with two earlier studies evaluating several shift system intervention (14, 17) and support expert views that the process prior to implementation of a new shift system might be as important as the actual change (9, 30). Smith et al. (17) showed that support prior to implementation, in terms of percentage of workers in favor of a new shift system, may explain differences in health gains between interventions after implementation. Using qualitative data from interviews, Albertsen et al. (14) reported that resistance to change may have influenced differences in changes in health effects between three intervention groups. In addition to the results of Smith et al. (17) and Albertsen et al. (14), our study is to our best knowledge the first to show a direct link between the individual attitude towards a new shift system prior to implementation and individual changes in mental self-rated health, work ability and work-family interference afterwards.

Table 7.3. Associations between attitude towards change, general health, work functioning, work ability and work-family interference (β=Beta, 95% CI=95% Confidence Interval)

	Total (N=59)		Intervention 1A (N=14)		Intervention 1B (N=18)		Intervention 2 (N=10)	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Model 1								
Mental health	3.14	1.32-4.97	0.71	-3.22-4.64	4.96	0.43-9.48	1.52	-0.85-3.89
Physical health	0.88	-0.68-2.44	-1.23	-4.61-2.16	1.38	-0.85-3.60	-0.75	-3.89-2.40
Work functioning	3.95	1.17-6.73	1.57	-4.85-7.99	2.20	-3.57-7.96	-0.02	-5.99-5.95
Work ability	0.52	0.22-0.81	0.02	-0.38-0.42	0.43	-0.24-1.10	0.47	-0.85-1.80
Work-family conflict	-5.62	-9.92 - -1.32	-6.46	-12.79--0.14	-11.28	-24.72-2.15	-5.28	-18.46-7.90
Family-work conflict	-3.63	-7.90-0.63	-5.43	-12.87-2.01	-4.34	-18.00-9.32	-1.60	-18.55-15.36
*Model 2**								
Mental health	3.44	1.44-5.43	-		-		-	
Physical health	0.43	-1.25-2.10	-		-		-	
Work functioning	2.71	-0.26-5.67	-		-		-	
Work ability	0.43	0.12-0.74	-		-		-	
Work-family conflict	-6.31	-10.94 - -1.67	-		-		-	
Family-work conflict	-5.19	-9.76 - -0.62	-		-		-	
*Model 3***								
Mental health	2.38	0.73-4.04	-		-		-	
Physical health	0.80	-0.86-2.45	-		-		-	
Work functioning	4.04	1.20-6.88	-		-		-	
Work ability	0.48	0.23-0.72	-		-		-	
Work-family conflict	-3.57	-6.94 - -0.20	-		-		-	
Family-work conflict	-1.51	-4.64-1.62	-		-		-	

* Adjusted for age, gender, care for children and follow-up time
** Adjusted for baseline scores mental health, physical health, work functioning, work ability, work family conflict and family-work conflict

Post-hoc analyses showed no associations for the attitude towards the shift system intervention and baseline age, self-rated mental and physical health, work functioning, work ability and work-family interference. Our results are partially in line with previous research. In a study among police officers the attitude towards a hypothetical new shift system did also not differ according to health complaints (19). Yet, in other studies preferences concerning shift workers' current or hypothetical shift systems differed according to age (19-21). The authors suggest that these differences might be due to shift workers' experience of their current shift schedule. In our study, the intervention context might better than personal characteristics explain differences in the attitude towards the new shift system. For example, when a new shift system has to be implemented due to downsizing (intervention 3), the attitude towards the new shift system will probably be more negative than in case shift workers request a new shift system themselves (intervention 2).

A more in-depth exploration of the intervention contexts may help to better understand the effects of the workers attitude towards a new shift system and towards changes in self-rated mental health, work ability and work-family conflict. First, organizational reorganizations may explain associations for a positive attitude towards change with changes in self-rated mental health and work ability. In our study, four (1A, 1B & 3-5) out of five shift system interventions were implemented because of an organizational reorganization, including a new shift system. Albertsen et al. (14) suggested that organizational interventions aimed at improving organizational performance, instead of improving worker wellbeing, may result in resistance to change. Several studies have shown negative effects of organizational changes on measures related to mental health and work ability, like increased work stress, disturbed sleep, incomplete recovery, hospital admission, sickness absence, work ability and work disability (31-37).

Second, workers' attitude towards and satisfaction with new shift systems may depend largely upon effects on the social life (38), e.g. the number of weekends off or many consecutive days off. In our study, three interventions (1A, 3 & 5) had an impact on social life. The shift system of interventions 3 and 5 were designed to adhere to ergonomic shift scheduling recommendations (9) by decreasing the number of consecutive shifts and working days and to introduce forward rotation. Adhering to these recommendations created a very irregular shift schedule, resulting in difficulties planning work and social life. Moreover, in these two interventions work during the weekends was introduced. For intervention 1A the shift workers had to give up their self-constructed schedule with ample full weekends (Saturday and Sunday) off. For these three interventions, workers' expectations of negative effects on their social life may have actually became real in the new shift systems.

Third, null findings between the attitude towards change and changes in self-rated physical health and work functioning may be due to the relatively low impact of the shift system interventions on the actual work content, which might have led to low variability in change scores. Also in previous shift system intervention studies, almost no effects were found on

physical health (11). Concerning work functioning, the WRFQ measures perceived difficulties in meeting work demands (25) and the interventions did not affect the work demands. Finding no associations for self-rated physical health and work functioning might also be due to the short follow-up period or a relative healthy worker population, given similar scores on self-rated physical health and work functioning compared to other worker populations (e.g. (25, 39-41)).

Strengths and limitations

This is the first study examining the shift workers' attitude towards a shift system intervention with a change in self-rated health, work functioning, work ability and work-family interference. A pre-/post-measurement design was used with validated measures of self-rated health, work and social life. Several limitations should be noted. First, although the overall response rate was acceptable, the number of participants with complete data was rather low. The small sample size might be due to resistance towards change with the possible consequence of selection bias. Only those workers in favor or against the new shift system may find it worthwhile to participate in the shift system evaluation. Participants with complete data at baseline and follow-up reported better scores on self-rated health, work functioning and work-family conflict, compared to participants who completed only the follow-up questionnaire. Shift workers disliking the intervention might have feel urged to participate in the follow-up measurement, even without participating in the baseline measurement. Second, the small sample size allowed only a limited number of covariates to be entered in the analyses. Other relevant covariates, like lifestyle (e.g. drinking, smoking, physical activity), indicators of health status (e.g. BMI, medication use) or work-related factors (e.g. job demands, decision latitude) were not included. Third, the number of interventions was too small to apply multilevel analyses to take into account company and intervention effects. Fourth, the study sample comprised mainly male industrial worker. Therefore, the results cannot be generalized to other occupational groups or females.

Implication for research and practice

Future shift system intervention studies should incorporate workers' attitude towards the intervention in the evaluation protocol. Whether our results hold for other frequently used constructs in shift work research, like performance, sleep and fatigue-related measures, or objective assessments has yet to be examined.

Organizations that consider a shift system intervention should be aware of the possible effect of the shift workers' attitude before implementation on changes in self-rated health, work and social outcomes after implementation. A careful process before implementation is suggested to positively influence shift workers' attitude towards a new shift system. To do so, shift work experts advocate worker participation, continuous information and communication, use of champions of change, proper project management and an effect evaluation to influence shift workers' attitude towards and acceptance of a new shift system (9, 30).

Summary and conclusion

In summary, a positive attitude towards a shift system intervention prior to implementation is prospectively related with better mental self-rated health and work ability and less work-family interference after implementation. The results highlight that the worker' attitude may affect evaluation results when implementing new shift systems, which suggests the need for a careful process before implementation of new shift systems. Future shift system intervention studies with a larger sample size and a longer follow-up time are needed to replicate our findings.

References

1. Knutsson A. Health disorders of shift workers. Occup Med (Lond). 2003;53(2):103-8.
2. Albertsen K, Rafnsdóttir GL, Grimsmo A, Tomasson K, Kauppinen K. Workhours and worklife balance. Scand J Work Environ Health. 2008;34(5):14.
3. Åkerstedt T, Wright KP. Sleep Loss and Fatigue in Shift Work and Shift Work Disorder. Sleep Med Clin. 2009;4(2):257-71.
4. Knutsson A, Boggild H. Gastrointestinal disorders among shift workers. Scand J Work Environ Health. 2010;36(2):85-95.
5. Puttonen S, Härmä M, Hublin C. Shift work and cardiovascular disease - pathways from circadian stress to morbidity. Scand J Work Environ Health. 2010;36(2):96-108.
6. Kantermann T, Juda M, Vetter C, Roenneberg T. Shift-work research: Where do we stand, where should we go? Sleep and Biological Rhythms. 2010;8(2):95-105.
7. Wang F, Zhang L, Zhang Y, Zhang B, He Y, Xie S, et al. Meta-analysis on night shift work and risk of metabolic syndrome. Obesity Reviews. 2014;15(9):709-720.
8. Pallesen S, Bjorvatn B, Mageroy N, Saksvik IB, Waage S, Moen BE. Measures to counteract the negative effects of night work. Scand J Work Environ Health. 2010;36(2):109-20.
9. Knauth P, Hornberger S. Preventive and compensatory measures for shift workers. Occup Med (Lond). 2003;53(2):109-16.
10. Sallinen M, Kecklund G. Shift work, sleep, and sleepiness - differences between shift schedules and systems. Scand J Work Environ Health. 2010;36(2):121-33.
11. Bambra CL, Whitehead MM, Sowden AJ, Akers J, Petticrew MP. Shifting schedules: the health effects of reorganizing shift work. Am J Prev Med. 2008;34(5):427-34.
12. Garde AH, Albertsen K, Nabe-Nielsen K, Carneiro IG, Skotte J, Hansen SM, et al. Implementation of self-rostering (the PRIO project): effects on working hours, recovery, and health. Scand J Work Environ Health. 2012;38(4):314-26.
13. Nijp HH, Beckers DG, Geurts SA, Tucker P, Kompier MA. Systematic review on the association between employee worktime control and work-non-work balance, health and well-being, and job-related outcomes. Scand J Work Environ Health. 2012;38(4):299-313.
14. Albertsen K, Garde AH, Nabe-Nielsen K, Hansen ÅM, Lund H, Hvid H. Work-life balance among shift workers: results from an intervention study about self-rostering. Int Arch Occup Environ Health. 2014;87(3):265-74.
15. Blok MM, de Looze MP. What is the evidence for less shift work tolerance in older workers? Ergonomics. 2011;54(3):221-32.
16. Jeppesen HJ. Participatory approaches to strategy and research in shift work intervention. Theoretical Issues in Ergonomics Science. 2003;4(3-4):289-301.
17. Smith PA, Wright BM, Mackey RW, Milsop HW, Yates SC. Change from slowly rotating 8-hour shifts to rapidly rotating 8-hour and 12-hour shifts using participative shift roster design. Scand J Work Environ Health. 1998;24:55-61.
18. Axelsson J, Åkerstedt T, Kecklund G, Lowden A. Tolerance to shift work-how does it relate to sleep and wakefulness? Int Arch Occup Environ Health. 2004;77(2):121-9.
19. Kecklund G, Eriksen CA, Åkerstedt T. Police officers attitude to different shift systems: Association with age, present shift schedule, health and sleep/wake complaints. Appl Ergon.;39(5):565-71.
20. Nabe-Nielsen K, Kecklund G, Ingre M, Skotte J, Diderichsen F, Garde AH. The importance of individual preferences when evaluating the associations between working hours and indicators of health and well-being. Appl Ergon. 2010;41(6):779-86.
21. Nabe-Nielsen K, Jensen MA, Hansen ÅM, Kristiansen J, Garde AH. What is the preferred number of consecutive night shifts? results from a crossover intervention study among police officers in Denmark. Ergonomics. 2016;59(10):1392-402.
22. van de Ven, Hardy A, van der Klink, JJL, Vetter C, Roenneberg T, Gordijn M, Koolhaas W, et al. Sleep and need for recovery in shift workers: do chronotype and age matter? Ergonomics. 2016;59(2):310-324.
23. van de Ven, Hardy A, Brouwer S, Koolhaas W, Goudswaard A, de Looze MP, Kecklund G, et al. Associations between shift schedule characteristics with sleep, need for recovery, health and performance measures for regular (semi-) continuous 3-shift systems. Appl Ergon. 2016;56:203-12.
24. Ware J,Jr, Kosinski M, Keller SD. A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. Med Care. 1996 Mar;34(3):220-33.

25. Abma FI, van der Klink, JJL, Bültmann U. The work role functioning questionnaire 2.0 (Dutch version): examination of its reliability, validity and responsiveness in the general working population. J Occup Rehabil. 2013;23(1):135-47.
26. Ilmarinen J. The work ability index (WAI). Occupational Medicine. 2007;57(2):160-.
27. Ahlstrom L, Grimby-Ekman A, Hagberg M, Dellve L. The work ability index and single-item question: associations with sick leave, symptoms, and health–a prospective study of women on long-term sick leave. Scand J Work Environ Health. 2010:404-12.
28. El Fassi M, Bocquet V, Majery N, Lair ML, Couffignal S, Mairiaux P. Work ability assessment in a worker population: comparison and determinants of Work Ability Index and Work Ability score. BMC Public Health. 2013;13:305,2458-13-305.
29. Pejtersen JH, Kristensen TS, Borg V, Bjorner JB. The second version of the Copenhagen Psychosocial Questionnaire. Scand J Public Health. 2010;38(3 Suppl):8-24.
30. Knauth P. Strategies for the implementation of new shift systems. J Hum Ergol (Tokyo). 2001;30(1-2):9-14.
31. Vahtera J, Kivimaki M, Pentti J. Effect of organisational downsizing on health of employees. The Lancet. 1997;350(9085):1124-8.
32. Westerlund H, Ferrie J, Hagberg J, Jeding K, Oxenstierna G, Theorell T. Workplace expansion, long-term sickness absence, and hospital admission. The Lancet. 2004;363(9416):1193-7.
33. Hansson A, Vingård E, Arnetz BB, Anderzén I. Organizational change, health, and sick leave among health care employees: A longitudinal study measuring stress markers, individual, and work site factors. Work & Stress. 2008;22(1):69-80.
34. Virtanen M, Kivimaki M, Singh-Manoux A, Gimeno D, Shipley MJ, Vahtera J, et al. Work disability following major organisational change: the Whitehall II study. J Epidemiol Community Health. 2010;64(5):461-4.
35. Dahl MS. Organizational change and employee stress. Management Science. 2011;57(2):240-56.
36. Greubel J, Kecklund G. The impact of organizational changes on work stress, sleep, recovery and health. Ind Health. 2011;49(3):353-64.
37. Falkenberg H, Fransson EI, Westerlund H, Head JA. Short- and long-term effects of major organisational change on minor psychiatric disorder and self-rated health: results from the Whitehall II study. Occup Environ Med. 2013;70(10):688-96.
38. Kandolin I, Huida O. Individual flexibility: an essential prerequisite in arranging shift schedules for midwives. J Nurs Manag.;4(4):213-7.
39. Mols F, Pelle AJ, Kupper N. Normative data of the SF-12 health survey with validation using postmyocardial infarction patients in the Dutch population. Quality of Life Research. 2009;18(4):403-14.
40. Rodilla R, María J, i Clanchet D, Amick BC, Abma FI, Pidemunt G, et al. Responsiveness of the Work Role Functioning Questionnaire (Spanish version) in a general working population. Journal of Occupational and Environmental Medicine. 2014;56(2):189-194.
41. van de Ven, HA, Bültmann U, de Looze MP, Koolhaas W, Kantermann T, Brouwer S, et al. Need for recovery among male technical distal on-call workers. Ergonomics. 2015;58(12):1927-38.